Comparative Fire Resistance of Roofing Materials

Published by
Shingle Branch, West Coast Lumbermen's Association
Seattle, Wash.

INTRODUCTION

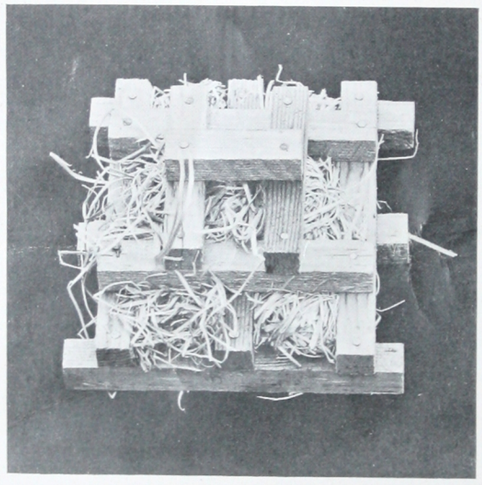
In fairness to one of America's greatest industries—an industry that for nearly a century has housed the nation—we ask those interested to give careful consideration to the report which appears herewith.

This report is that of a fire test conducted by the Forestry Department of the University of Washington to ascertain the fire-resistant qualities of fifteen different roofs.

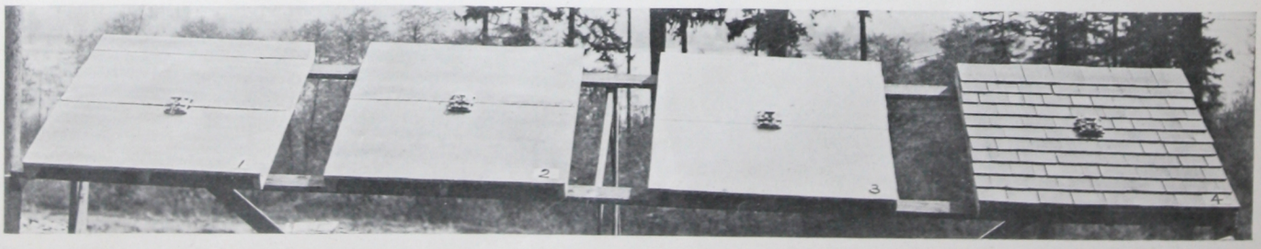
The test was conducted by Professor Bror L. Grondal, and took place May 3, 1917.

Photographic Record of the Test with Explanation and Details

*Sixteen different roofs were built according to standard building requirements, consisting of twelve of the leading advertised brands of prepared or patent roofings, also two treated and one untreated Red Cedar shingle roofs.



The above is a photograph showing details of the standard fire brand used on all of the roofs. The group below shows how this fire brand was placed on the different roofs before ignition.



** Only fifteen roofs were used in the test.*

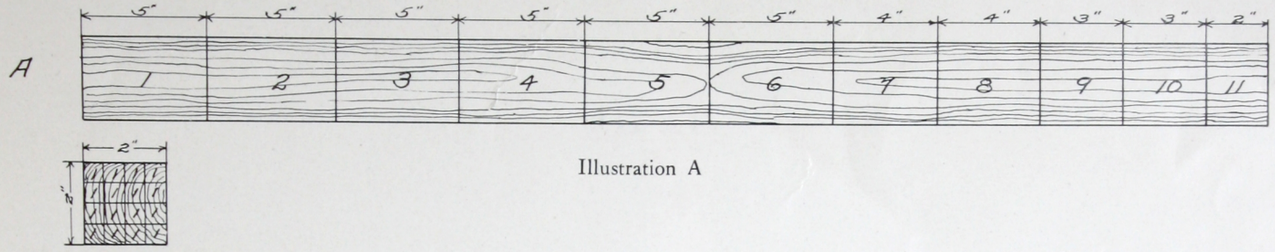


Illustration A

The diagrams on this page show the manner in which each section of the brand was selected. To avoid the slightest variation between any of the *sixteen fire brands a piece of air-dried fir 46 inches long and 2 inches by 2 inches cross section was carefully selected. This piece just accommodated in length the eleven pieces or sections required for the brands. See illustration "A." Each cross section permitted sixteen pieces ½ inch by ½ inch from each length. One of these pieces, ½ inch by ½ inch, was used in the same identical place in the construction of each of the sixteen different brands, thus positively eliminating any variation. The small sections were identical in form and size, and the brands when completed weighed exactly the same to a fraction of an ounce.

The excelsior used was carefully weighed and placed in each brand in exactly the same manner.

Just before igniting each brand was treated with 15 c. c. of kerosene oil.

The brands were all ignited at the same time and burned uniformly. The structure of the brands is explained in this lengthly detail to show that every variable was eliminated as the value of the comparison depended on their uniformity.

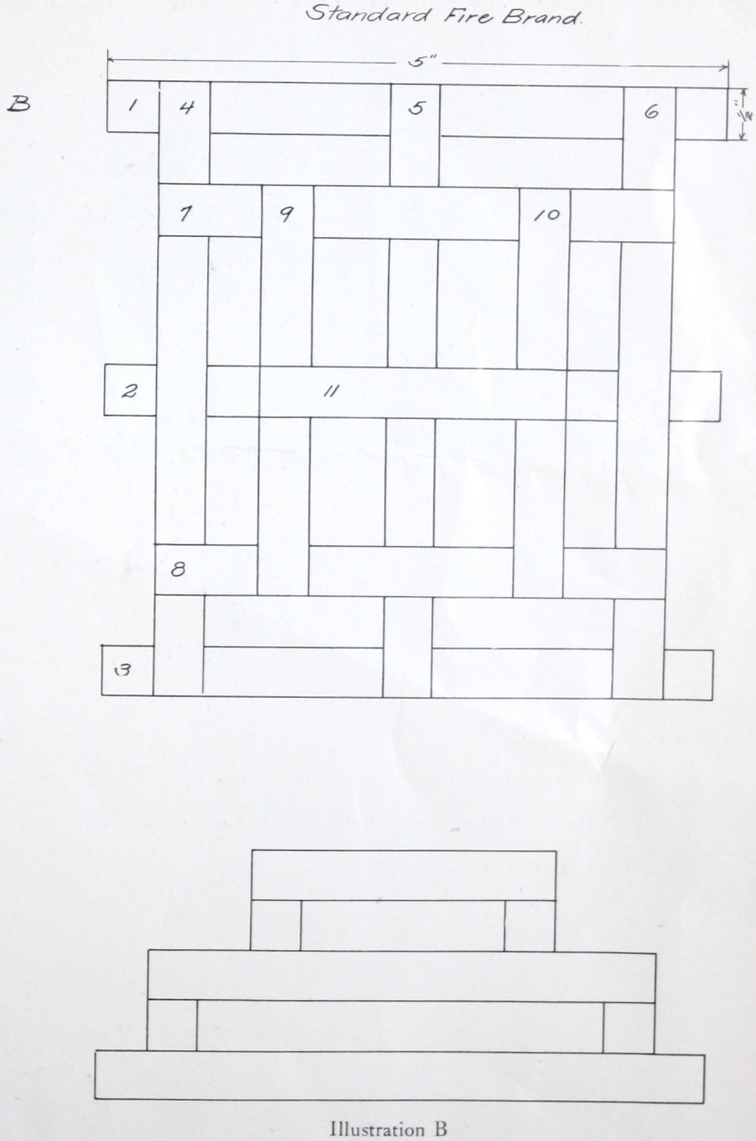
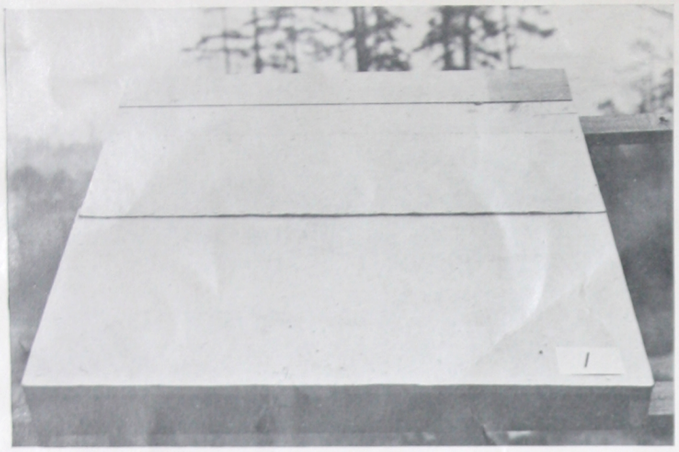
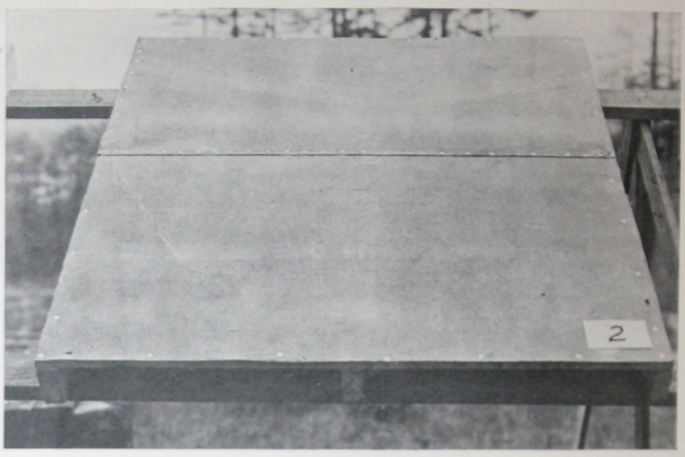


Illustration B

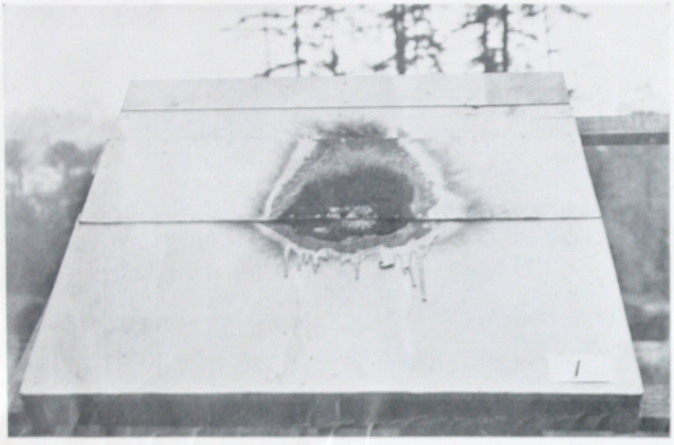
* *Sixteen brands built, fifteen used.*



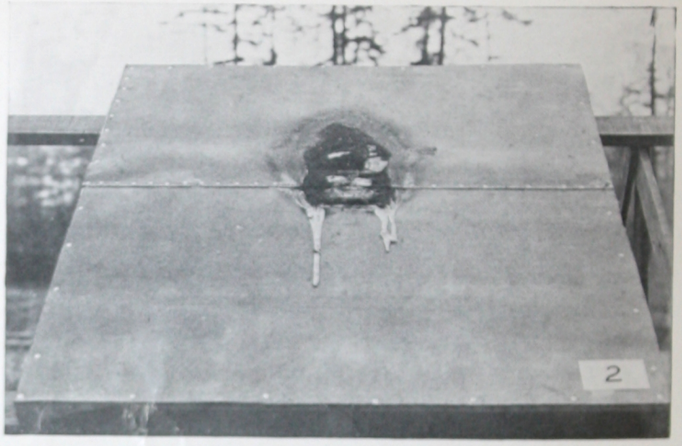
No. 1—High grade, 3-ply, prepared roofing. Before ignition.



No. 2—High grade, 3-ply, prepared roofing. Before ignition.



No. 1—Above roof after fire had burned itself out.

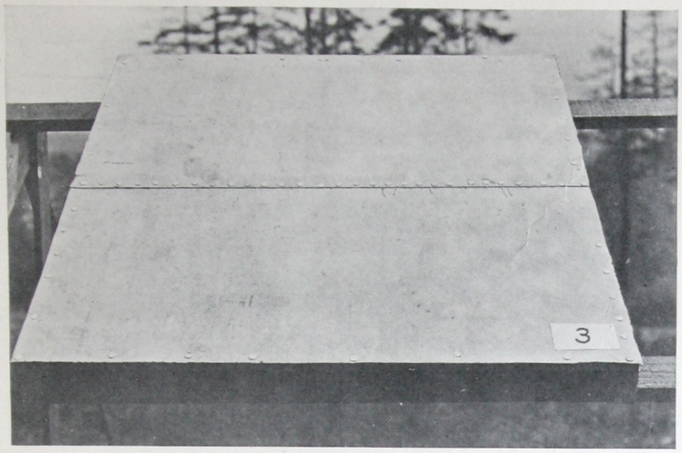


No. 2—Above roof after fire had burned itself out.

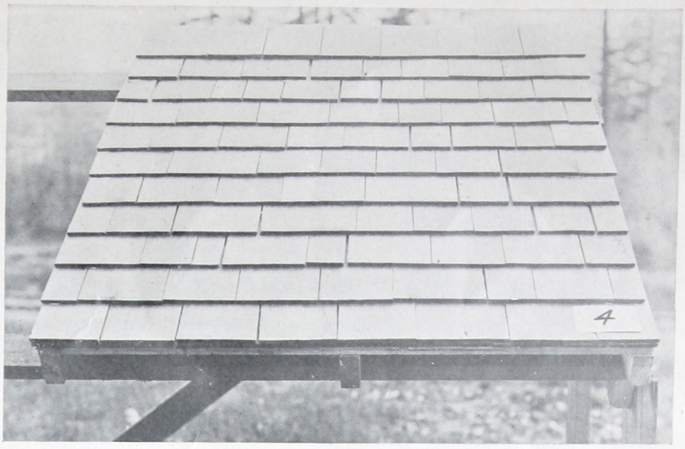
No. 1—Showing damage done to sheathing.

No. 2—Showing damage done to sheathing.

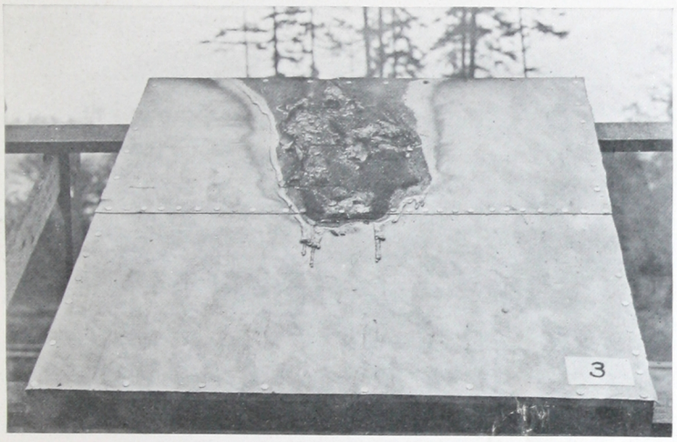
Nos. 1, 2, 3 and 4 Roofs, 3 minutes and 30 seconds after ignition.



No. 3—High grade, 2-ply, prepared roofing. Before ignition.



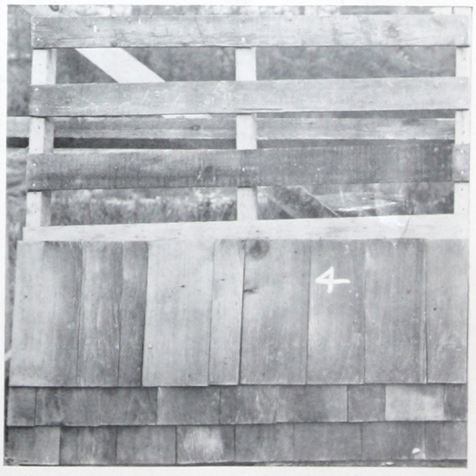
No. 4—RED CEDAR SHINGLES treated with fire-retardant solution (commercial treatment). Before ignition.



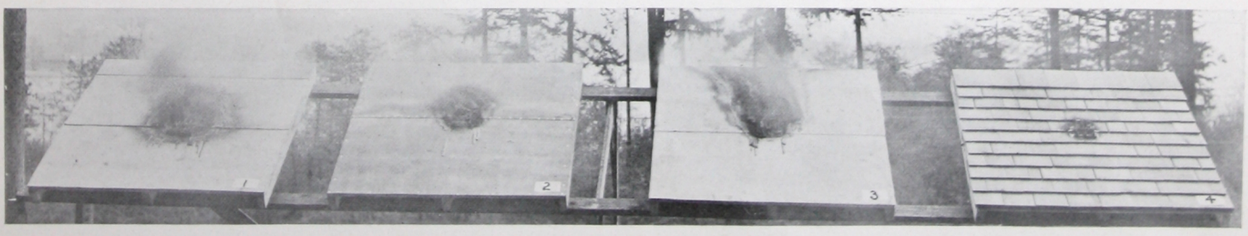
No. 3—Above roof after fire had burned itself out.

No. 4—Above roof after fire had burned itself out.

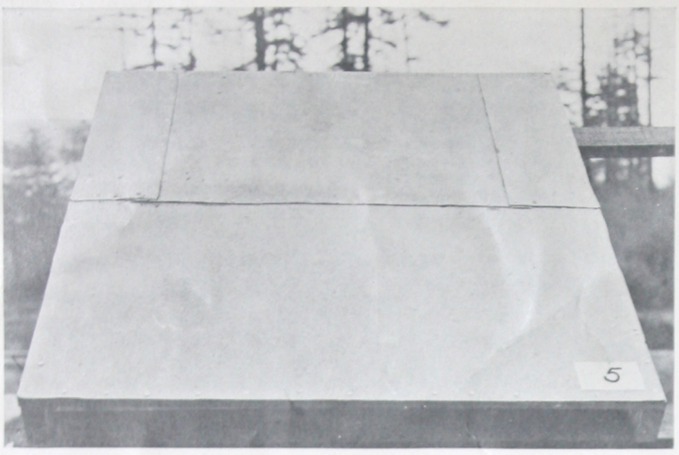
No. 3—Showing damage done to sheathing.



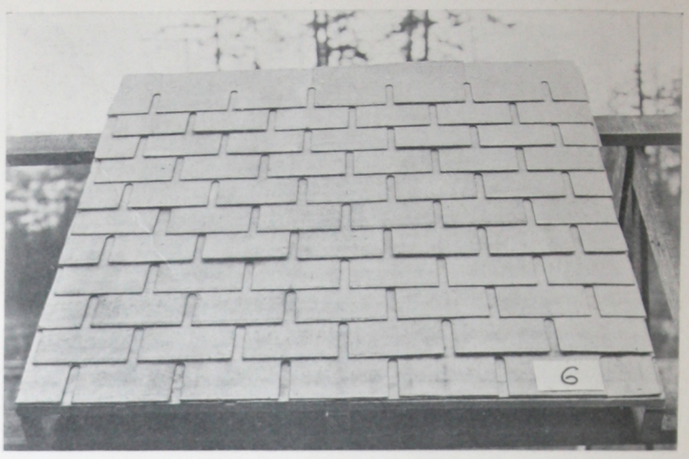
No. 4—Showing sheathing not even scorched.



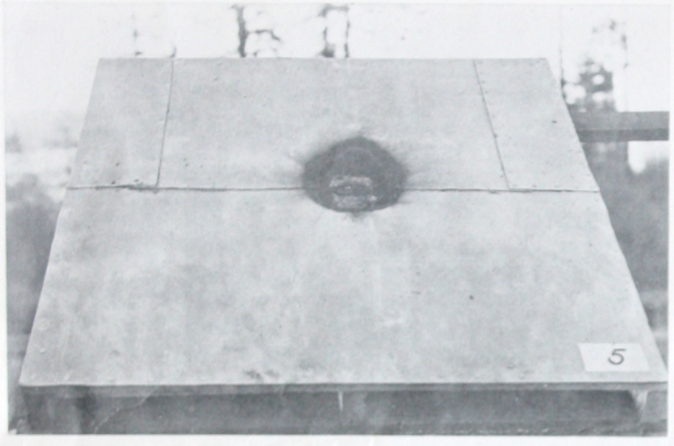
Nos. 1, 2, 3 and 4 Roofs, 5 minutes and 30 seconds after ignition.



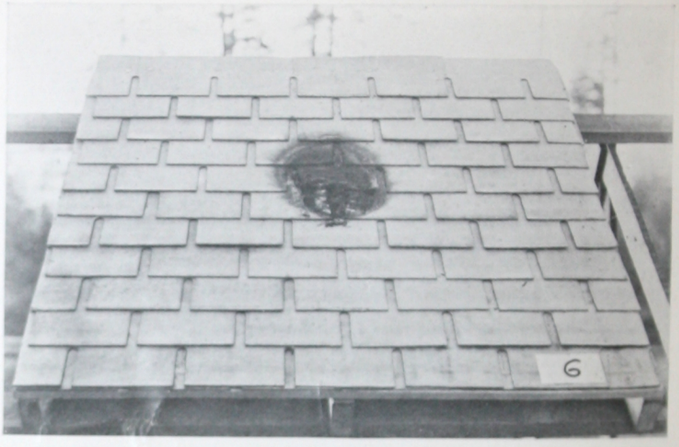
No. 5—High grade, 3-ply, prepared roofing. Before ignition.



No. 6—High grade patent shingles. Before ignition.



No. 5—Above roof after fire had burned itself out.



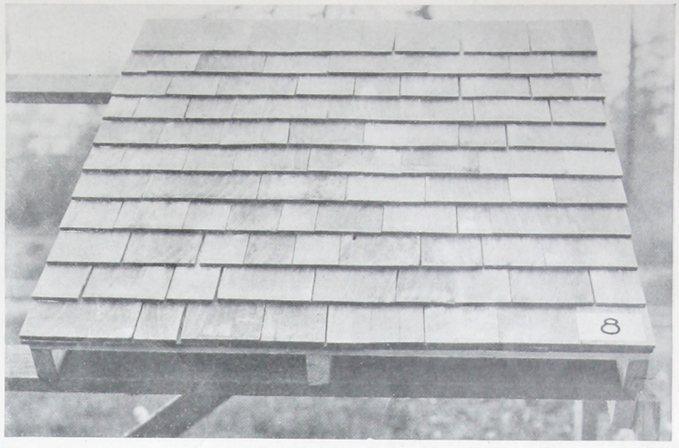
No. 6—Above roof after fire had burned itself out.

No. 5—Showing damage done to sheathing.

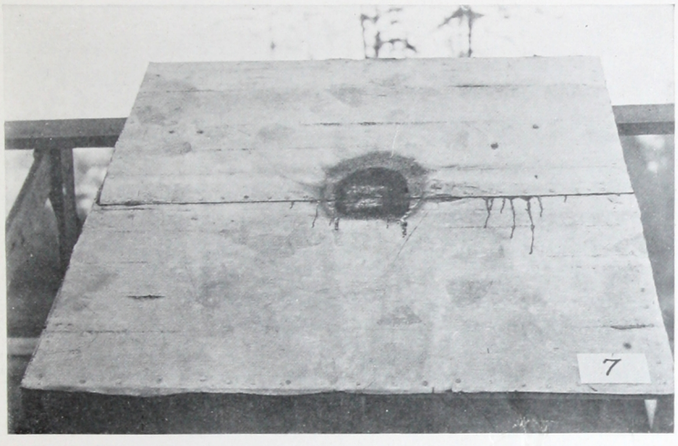
No. 6—Showing damage done to sheathing.

Nos. 5, 6, 7 and 8 Roofs, 7 minutes and 30 seconds after ignition.

No. 7—High grade, 2-ply, prepared roofing. Before ignition.



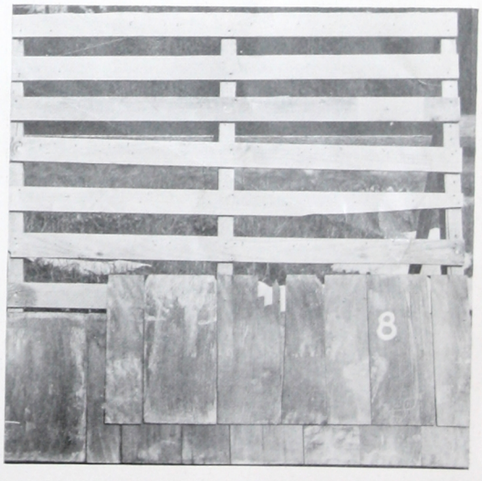
No. 8—RED CEDAR SHINGLES treated with fire-retardant.



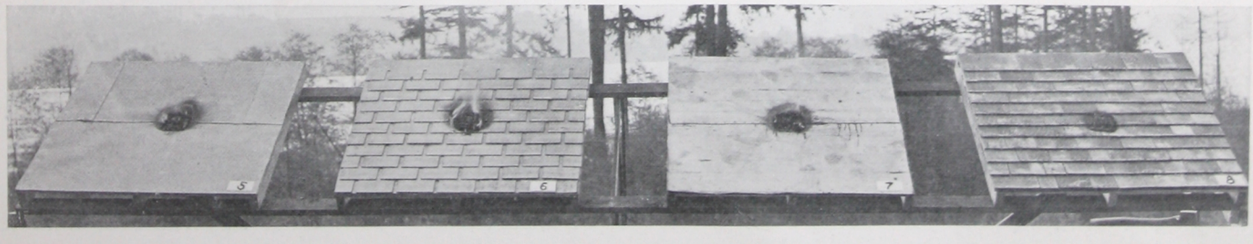
No. 7—Above roof after fire had burned itself out.

No. 8—Above roof after fire had burned itself out.

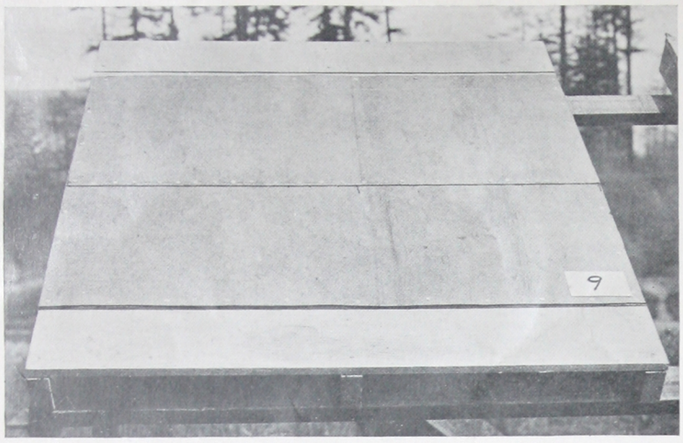
No. 7—Showing damage done to sheathing.



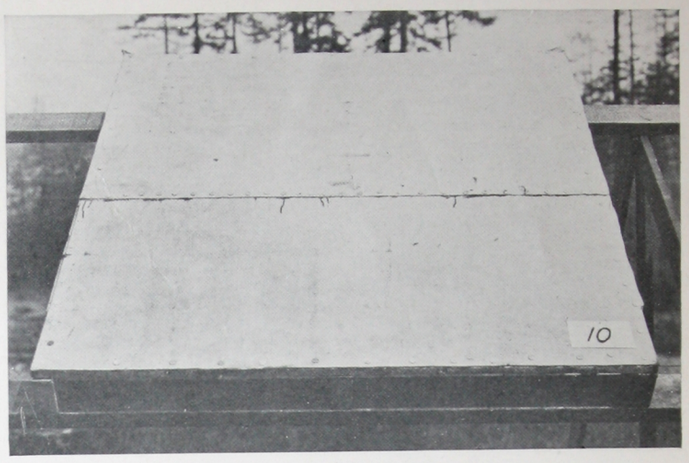
No. 8—Showing sheathing not even scorched.



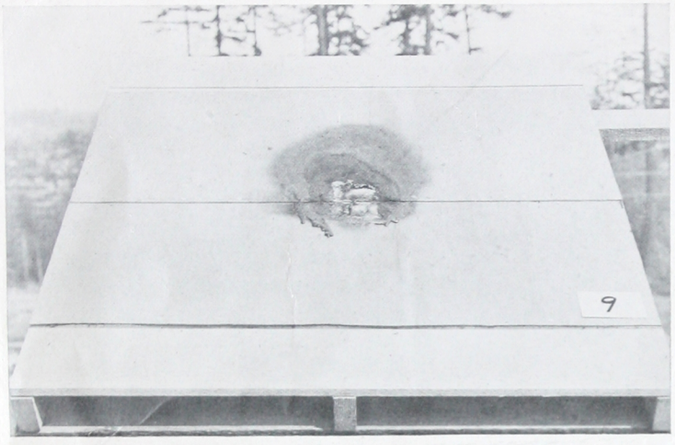
Nos. 5, 6, 7 and 8 Roofs, 10 minutes after ignition.



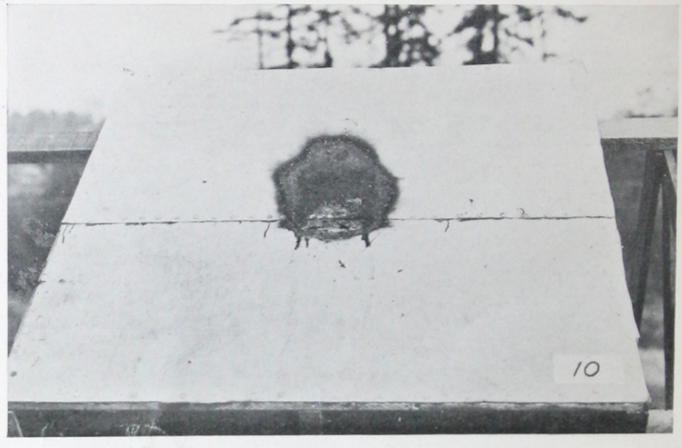
No. 9—High grade, extra heavy, prepared roofing. Before ignition.



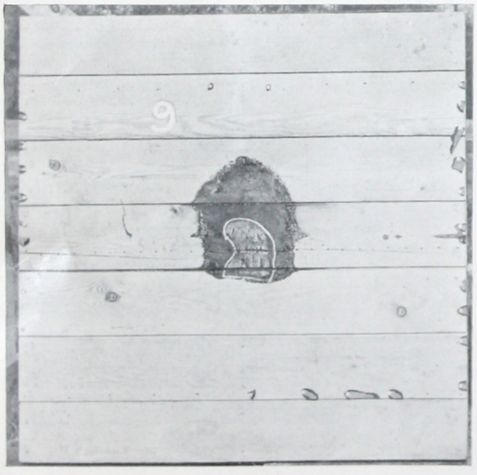
No. 10—High grade, 1-ply, prepared roofing. Before ignition.



No. 9—Above roof after fire had burned itself out.

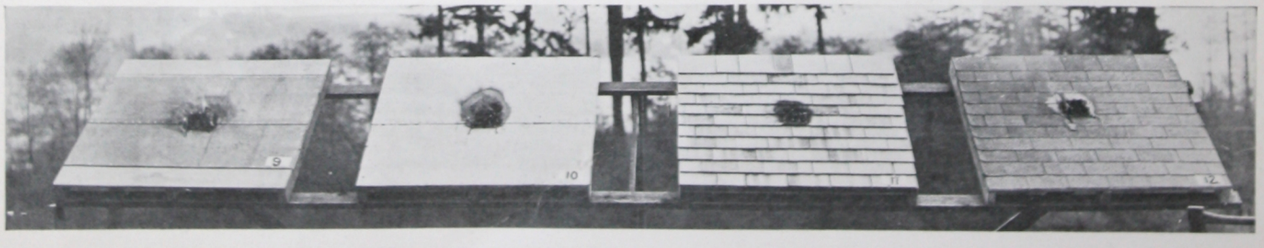


No. 10—Above roof after fire had burned itself out.

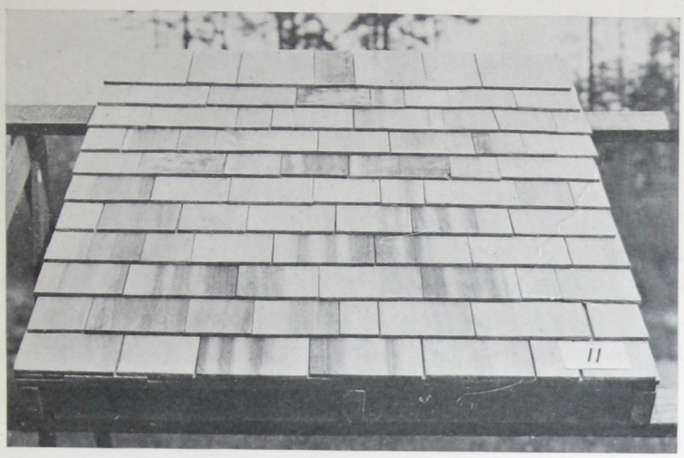


No. 9—Showing damage done to sheathing.

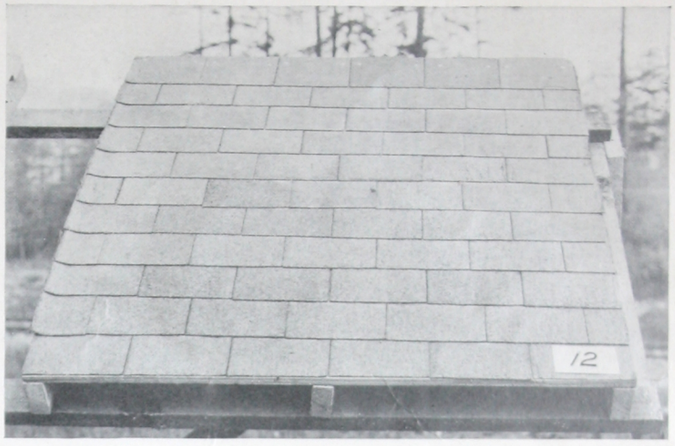
No. 10—Showing damage done to sheathing.



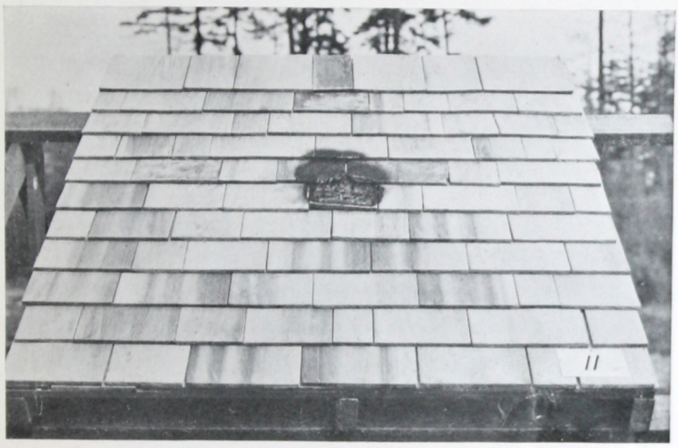
Nos. 9, 10, 11 and 12 Roofs, 5 minutes after ignition.



No. 11—RED CEDAR SHINGLES not protected or treated in any way. Before ignition.

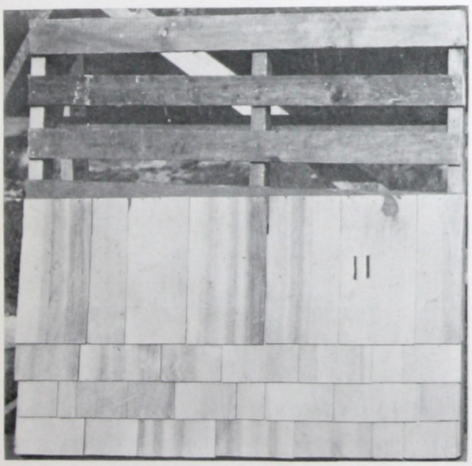


No. 12—High grade patent shingles. Before ignition.



No. 11—Above roof after fire had burned itself out.

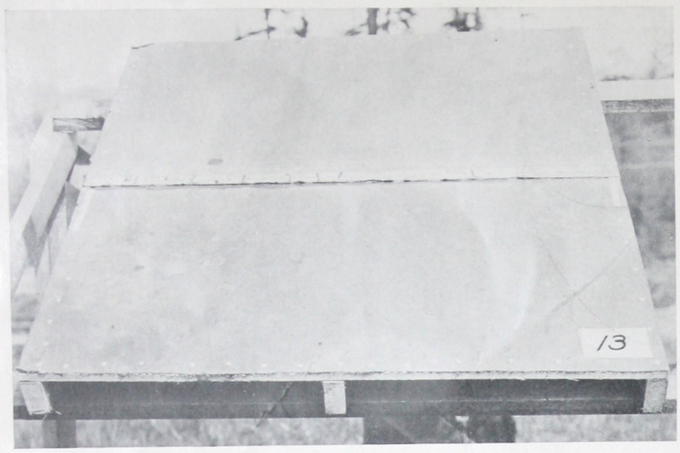
No. 12—Above roof after fire had burned itself out.



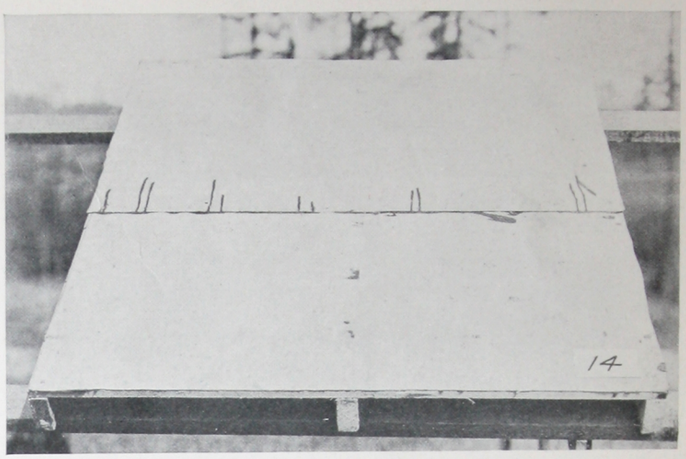
No. 11—Showing that fire did not even scorch the third course of shingles.

No. 12—Showing damage done to sheathing.

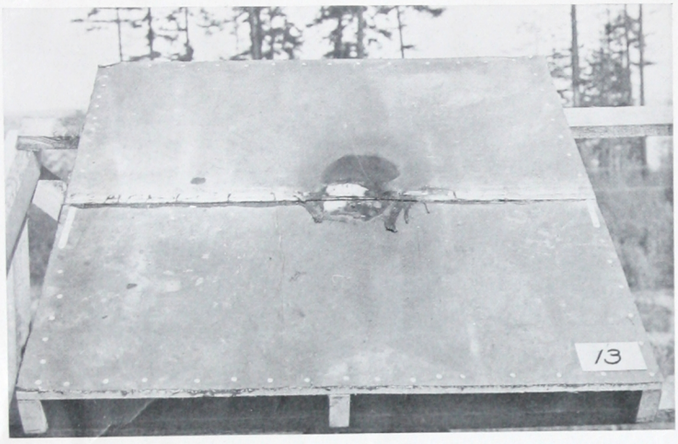
In all these photographs the fact is clearly shown that Red Cedar Shingles did not support combustion nearly so readily as the patent roofings.



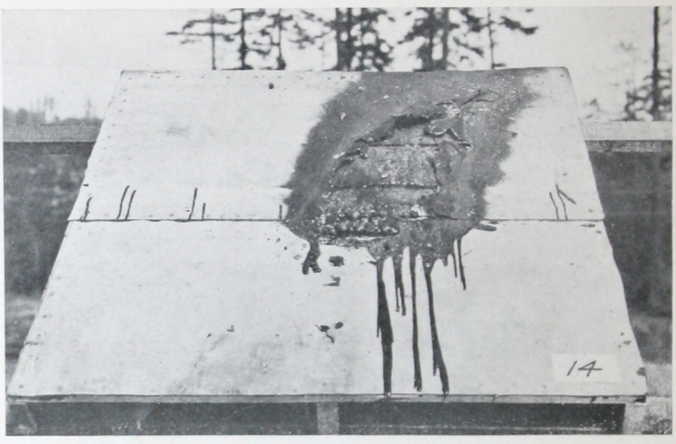
No. 13—High grade, prepared roofing. Before ignition.



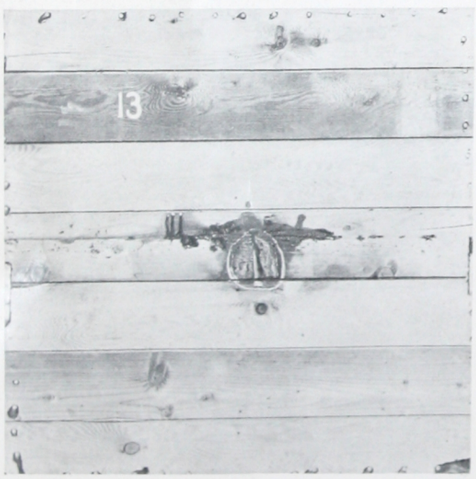
No. 14—High grade, 2-ply, prepared roofing. Before ignition.



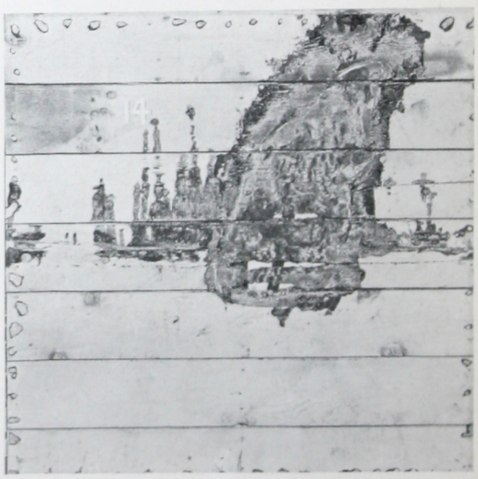
No. 13—Above roof after fire had burned itself out.



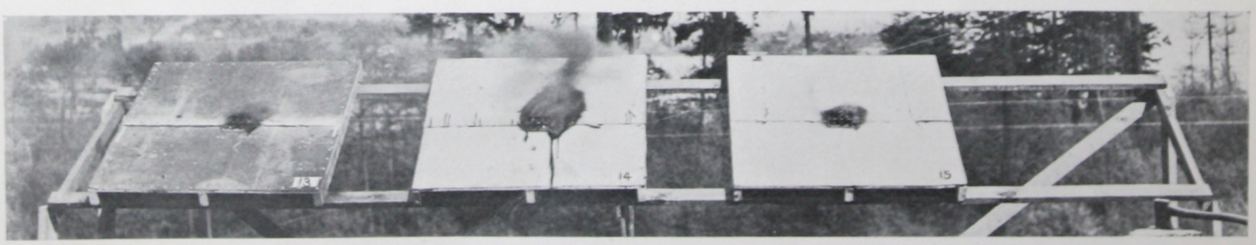
No. 14—Above roof after fire had burned itself out.



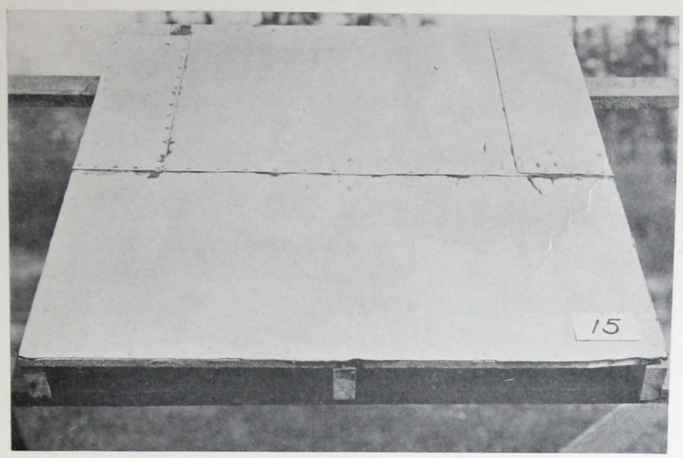
No. 13—Showing damage done to sheathing.



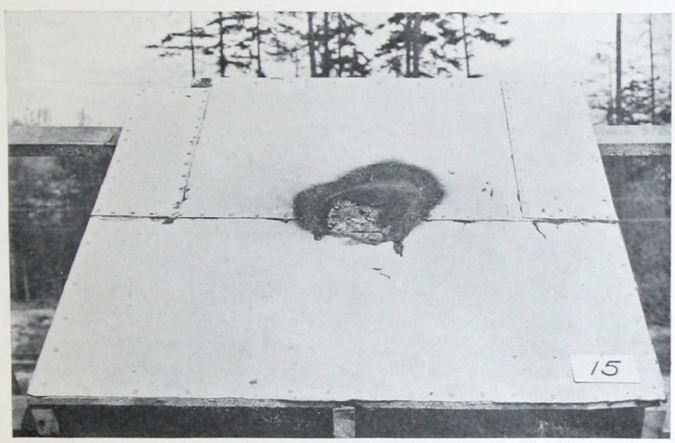
No. 14—Showing damage done to sheathing.



Nos. 13, 14 and 15 Roofs, 3 minutes and 30 seconds after ignition.



No. 15—High grade, 2-ply, prepared roofing. Before ignition.



No. 15—Above roof after fire had burned itself out.

No. 15—Showing damage done to sheathing.

IMPORTANT

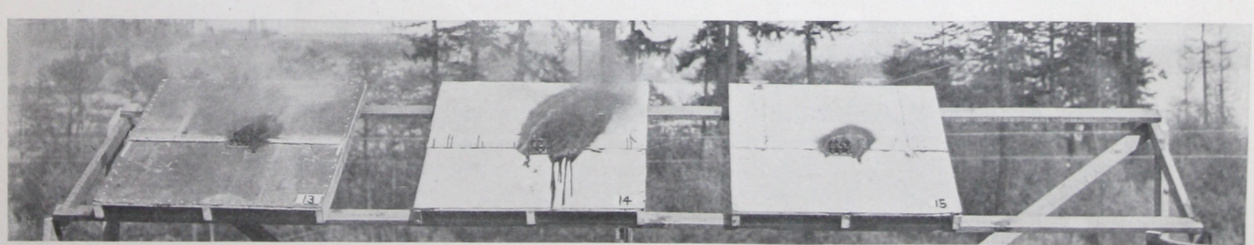
June 13th, 1917.

Supplement to Report of May 3rd on

"Tests of Roofing Materials to Determine Their Comparative Fire Resistance"

The series of tests made May 3rd were duplicated June 12th. The results of these check tests conformed closely with the original series. A photographic record of the second series is on file at the University of Washington.

BROR L. GRONDAL,
Assistant Professor of Forestry,
University of Washington.



Nos. 13, 14 and 15 Roofs, 5 minutes after ignition.

Test of Roofing Materials to Determine their Comparative Fire Resistance

BROR L. GRONDAL, *Asst. Prof. of Forestry, University of Washington.*

Frequent assertions by manufacturers of roofings designed to replace wooden shingles that such "patent" roofings afford protection from fire, while western red cedar shingles presented an abnormally dangerous fire hazard, have led many people to use such roofings under the impression that they were "fire-proof." As fire records demonstrate rather conclusively that few fires originate through the ignition of wooden shingles by sparks, the claims of some of these manufacturers were investigated by students at the College of Forestry of the University several years ago, and the discovery was made that any pitch or asphalt-saturated roofing paper, or "fire-resisting" roofing, would burn vigorously when lighted with an ordinary parlor match. It was found to be more difficult to ignite western red cedar shingles in a similar manner, and they did not burn so rapidly. The claims of the manufacturers of "fire-resisting" or "patent" roofing were therefore viewed with some incredulity, but as exhaustive tests paralleling conditions which occur in general conflagrations had not been made, the results of these preliminary experiments were not given publicity.

Early in the spring of 1917 Secretary H. P. Wyckoff tendered the services of the Shingle Branch of the West Coast Lumbermen's Association in supplying material for a series of practical tests to determine the relative fire-resisting qualities of western red cedar shingles as compared with widely advertised substitutes. As it was felt that such data, whether favorable toward western red cedar shingles or not, would be of great interest to the public, the offer made by Mr. Wyckoff was immediately accepted by the College of Forestry. After a practical method of testing, which eliminated all serious variables, had been devised and checked by preliminary tests, the tests described in the following paragraphs were carried out.

Sixteen square roof sections, each having an area of sixteen square feet, were prepared according to the methods recommended by the manufacturers of each type of roofing. The roof sections carrying "patent" roofings were covered with 1 x 8 common shiplap. The western red cedar shingles were nailed to 1 x 3 common nailing strips. The sections were tested in lots of four, mounted on a common support having a one-third pitch, as illustrated in the photographs accompanying this report. The following brands of roofings were tested:

> No. 1—Vulcanite, 3 ply; No. 2—Premium, 3 ply; No. 3—Malthoid, 2 ply; No. 4—Kiln dried western red cedar shingles treated by immersion for one hour in Penetim fireproofing liquid; No. 5—Paroid, 3 ply; No. 6—Neponset shingles; No. 7—Amazon, 2 ply; No. 8—Kiln dried western red cedar shingles treated with zinc borate by the U. S. Forest Service at Madison, Wis.; No. 9—Vulcanite, extra heavy; No. 10—Ruberoid, 1 ply; No. 11—Kiln dried western red cedar shingles, untreated; No. 12—Barrett Tylike shingles; No. 13—Johns-Manville Asbestos roofing; No. 14—Certainteed, 2 ply; No. 15—Paroid, 2 ply; No. 16—Kiln dried western red cedar shingles treated with fireproof paint. (No. 16 was not tested, as the paint at the time of testing had not dried.)

After placing the roof sections upon the support, a standard firebrand built up with great care was attached to the roof in the center of the square. The firebrands were made from material cut from one close-grained Douglas fir plank. (See illustration page 3.) The weight of the wood and nails in each brand carried less than plus or minus 0.1 gram from an average weight of 114.5 grams. Exactly 13 grams of spruce excelsior were packed into each brand, and to insure quick and complete ignition, 15 cubic centimeters of kerosene were sprinkled over the excelsior in each brand immediately before they were ignited. To avoid the possible accidental displacement of the brands during the test, they were hung on the roof sections by a small shingle nail tacked into the roof. The brands were placed as illustrated on page 2.

The tests were carried out on May 3rd, 1917. The temperature during the testing of sections 1, 2, 3 and 4 averaged about 70 degrees F. Wind was absent and the sun was shining. Before the tests on sections 5, 6, 7 and 8 were started the sky became overcast with clouds, obscuring the sun, while the temperature fell 8 degrees. Upon the completion of this lot, rain interrupted the testing, and further tests were discontinued for about two hours, when the rain clouds dissipated. Sections 9, 10, 11, 12, 13, 14 and 15, which had in the meantime been placed under cover, were tested while the temperature was about 65 degrees F. During these tests the sun

was shining and wind was practically absent. It was noted that the first three sections tested were softer than those in the second run, and it is the opinion of the writer that had the tests been carried out under a hot summer sun, the asphalt or pitch-saturated roofings would have burned with even much greater vigor, while wooden shingles, containing no inflammable bituminous compounds which soften with heat, would have been relatively unaffected.

The four roof sections in each lot were ignited at the same instant by four attendants, and the time required for the roofing in each case to ignite, the time required for the roofing to burn through and the time required for the fire to burn out were carefully noted, with the following results:

TABLE

Roof No.	*Time required for roof to ignite*	*Time required for roofing to burn through*	*Time required for fire to burn itself out*	*Depth of char. in sheathing, Inches*	*Area of charring, Inches*	*REMARKS*
1	1 minute	4 minutes	10 minutes	.35	36	
2	1 minute	2 min. 20 sec.	10 minutes	.40	20	
3	1 minute	3 min. 40 sec.	18 min. 30 sec.	Through	200	Burned through sheathing in 12 min. 30 sec.
4	1 min. 30 sec.	Did not burn through	8 min. 30 sec.	None	None	
5	30 seconds	3 minutes	18 minutes	.50	25	
6	35 seconds	Did not burn through	15 min. 30 sec.	Scorched	4	
7	30 seconds	3 min. 30 sec.	14 minutes	.40	20	
8	2 min. 30 sec. began charring	Did not burn through	10 minutes	None	None	Shingles charred, but did not burn with flame.
9	40 seconds	4 min. 30 sec.	13 minutes	.50	25	
10	40 seconds	4 minutes	13 min. 30 sec.	.30	25	
11	45 seconds	Did not burn through	10 minutes.	Slight trace	.....	
12	30 seconds	4 minutes	14 min. 30 sec.	.10	10	
13	45 seconds	5 minutes	9 minutes	.15	20	
14	30 seconds	2 minutes	28 min. 30 sec.	Through	180	Sheathing practically destroyed.
15	30 seconds	2 minutes	10 min. 30 sec.	.50	25	

The results as shown in tabulated form above show that the fire-resistance of western red cedar roofings is greater than any of the "patent" roofings included in the test. Several of the "patent" roofings burned so vigorously that it is felt that they cannot be regarded as reasonably safe fire hazards. All of these roofings, with the exception of No. 6, quickly burned through to the sheathing. Roofing No. 6, however, burned vigorously. None of the western red cedar shingle sections, including the kiln dried untreated shingles, burned through to the nailing strips. It became evident during the test that as the western red cedar shingles contained no asphalt or pitch, they did not support combustion long enough for the fire to spread, due to the low heat conductivity of the wood. Large volumes of inflammable gas distilled from the asphalt or pitch-saturated roofings and escaped through the seams in the sheathing below. In the case of a dwelling covered with such roofing and exposed to a conflagration it seems evident that the accumulation of explosive gases in the attic would tremendously increase the fire hazard, for the flash of flame following the ignition of these gases would possibly ignite the framework of the entire roof.

CONCLUSIONS.

1. Roofings manufactured from paper containing rags, bark and similar combustible material should not be classed as fire-resisting roofings, for they readily support combustion.

2. Roofings saturated with asphalt or pitch burn very readily, and even though the paper base may be of non-combustible materials, fire is readily communicated to the sheathing below. Such roofings should therefore not be classed as fire-resisting.

3. Untreated western red cedar shingles constitute a relatively low fire hazard, and by the application of fireproofing compounds they can effectively be rendered fire-resisting.

The following letters explain more clearly than we can why Birmingham repealed its Anti-Shingle Ordinance

WEST COAST LUMBERMEN'S ASSOCIATION,
425-432 Henry Bldg.,
Seattle, Wash.

Gentlemen: Birmingham, Ala., April 15, 1917.

Your letter of the 7th inst. received.

For some time the City of Birmingham had on its statute books an anti-wooden-shingle law. Last spring it became necessary for me to roof my house and I began an investigation of the various composition roofing materials required by our city ordinance. I found that even the highest priced composition roofings were very unsatisfactory. I immediately began to agitate the repeal of the anti-wooden-shingle law and aroused great interest. Finally we induced the Commission to pass an ordinance permitting the use of wooden shingles treated with certain kinds of paint. This law is now in effect in this city.

In addition to a limited personal experience with composition roofing I have made a thorough investigation to determine its durability, fire-proof qualities, cost of putting it on, and cost per thousand shingles as compared to the cost of wooden shingles. Of course, I have not investigated prices except in the local market. I find that a good grade of wooden shingle roof will last at least four times as long as even the best composition roof. When treated with a fire-proof paint the wooden shingle is as near fire-proof as the composition roofing, especially after the composition roofing has been on for some months and has been exposed to our warm sun. We find that here in the South the heat usually causes the coating of gravel to loosen and run off, leaving a dry paper very inflammable. It costs more to lay a composition roof than a wooden shingle roof because of the necessity of double decking. And the cost of a good grade of wooden shingle is much less than that of the composition shingle which is placed upon the market as a reasonably good material. But as I stated above, actual experience has demonstrated that even the best composition roof will not last more than one fourth as long as the wooden shingle roof.

Scores of people who have been victims of composition roofing testified, at the various hearings held by the City Commission of Birmingham for the purpose of investigating the relative merits of the two kinds of roofing, to the general unsatisfactoriness of the composition shingle. The evidence was conclusive on the propositions that it is very difficult to lay composition roofings so that they are weather-proof even when first put on, that they have a very short life under any condition, that the gravel coating soon runs off, leaving a dry inflammable paper, and that they are generally unsatisfactory. Both sides were well represented at the hearings but the evidence was so strong against the composition roofing and actual experience had proven it so inferior to the wooden shingle that the overwhelming verdict of the investigation was in condemnation of the composition roof.

I have no objection to being quoted on the subject. I am so thoroughly convinced that laws, which compel people to use composition roofs instead of the superior wooden shingle, work a grave injustice on the property owner, that I am always glad of an opportunity to utter a word of protest against them.

I am, very truly yours,

Mrs.W.S.M./F.B. *(Signed)* MRS. W. S. MORROW.

CITY OF BIRMINGHAM

BOARD OF COMMISSIONERS

George B. Ward, *President*

James Weatherly — J. D. Truss

Arlie Barber — J. R. Hornady

C. B. Lloyd, *Secretary*

MR. H. P. WYCKOFF, *Secretary,*
Henry Building,
Seattle, Washington.

Nov. 6, 1916.

Dear Sir:

Replying to your letter of October 30, I beg to enclose herewith a copy of the ordinance adopted by the City Commission permitting the use of wooden shingles within the corporate limits.

This ordinance was adopted upon the request of a large majority of the property owners of the city.

Very truly yours,

CBL/OGB *(Signed)* C. B. LLOYD, *Secretary.*

Houston repealed its ordinance for very much the same reasons, and numerous other cities after making investigations and tests decided not to put their citizens to the expense that Houston and Birmingham did.

In Conclusion

What are the obvious conclusions to be drawn from such an astonishing revelation as the preceding pages bring forth? Does it not insist that Red Cedar Shingles must not be legislated against without the gravest implication of prejudice or ignorance?

Does it not prove that the moulding of public sentiment by misleading publicity is dangerous and accusations of competitors utterly unfounded?

But you say—"What about conflagrations?" True, wooden shingles burn in conflagrations. So do *brick, tile, slate, metal, composition—everything.* Authentic reports and post-fire investigations with very few exceptions all prove that conflagrations invariably start in factory or fireproof building zones, and when fanned by wind destroy everything.

Take for instance, the disastrous fires of Chicago, Baltimore, Boston, New Orleans, San Francisco, Bangor.

But we are not dealing with conflagrations which destroy everything, but with the residence risk—the individual home, and statistics do not show that the wooden shingle roof is a menace compared with other roofings. *When put to the test Red Cedar Shingles prove their superiority.* Yes, wooden shingles, treated or untreated, without paint or fire-retardant, resist fire better than the most expensive, to say nothing of the cheapest brands of prepared roofings.

It is not the desire of the manufacturers of wooden shingles to belittle or oppose sane fire protection, but is it not a mistake, is it not working a financial hardship on the builder, is it not economically wrong when searching for fire protection to compel a community by legislation to replace a superior product with an inferior product?

THE FOREGOING FACTS CLOSELY SHOW THAT WOODEN SHINGLES ARE INVARIABLY LESS HAZARDOUS THAN PREPARED ROOFINGS.

Respectfully submitted,

WEST COAST LUMBERMEN'S ASSOCIATION,

Henry Building, Seattle, Wash.